

Titles of Most Frequently Occurring Classifications of Patents Returned  
From A Search of 10202884 on August 15, 2003

- 3 73/863.12 (0 OR, 3 XR)  
Class 073 : MEASURING AND TESTING  
73/863 SAMPLER, SAMPLE HANDLING, ETC.  
73/863.11 .With heating or cooling  
73/863.12 ..And separation
- 3 250/288 (2 OR, 1 XR)  
Class 250 : RADIANT ENERGY  
250/281 IONIC SEPARATION OR ANALYSIS  
250/288 .With sample supply means
- 3 435/286.1 (0 OR, 3 XR)  
Class 435 : CHEMISTRY: MOLECULAR BIOLOGY AND MICROBIOLOGY  
  
435/283.1 APPARATUS  
435/286.1 .Including condition or time responsive control  
means
- 3 704/219 (1 OR, 2 XR)  
Class 704 : DATA PROCESSING: SPEECH SIGNAL PROCESSING,  
LINGUISTICS, LANGUAGE TRANSLATION, AND AUDIO  
COMPRESSION/DECOMPRESSION  
704/200 SPEECH SIGNAL PROCESSING  
704/201 .For storage or transmission  
704/219 ..Linear prediction
- 3 704/223 (2 OR, 1 XR)  
Class 704 : DATA PROCESSING: SPEECH SIGNAL PROCESSING,  
LINGUISTICS, LANGUAGE TRANSLATION, AND AUDIO  
COMPRESSION/DECOMPRESSION  
704/200 SPEECH SIGNAL PROCESSING  
704/201 .For storage or transmission  
704/221 ..Pattern matching vocoders  
704/223 ...Excitation patterns
- 2 73/863.11 (0 OR, 2 XR)  
Class 073 : MEASURING AND TESTING  
73/863 SAMPLER, SAMPLE HANDLING, ETC.  
73/863.11 .With heating or cooling
- 2 73/864.81 (0 OR, 2 XR)  
Class 073 : MEASURING AND TESTING  
73/863 SAMPLER, SAMPLE HANDLING, ETC.  
73/864.81 .Analyzer supplier
- 2 250/283 (0 OR, 2 XR)  
Class 250 : RADIANT ENERGY  
250/281 IONIC SEPARATION OR ANALYSIS  
250/282 .Methods  
250/283 ..With collection of ions
- 2 374/11 (1 OR, 1 XR)  
Class 374 : THERMAL MEASURING AND TESTING

374/10 DIFFERENTIAL THERMAL ANALYSIS  
374/11 .Detail of electrical heating control

2 422/80 (0 OR, 2 XR)  
Class 422 : CHEMICAL APPARATUS AND PROCESS DISINFECTING,  
DEODORIZING; PRESERVING, OR STERILIZING  
422/50 ANALYZER, STRUCTURED INDICATOR, OR MANIPULATIVE  
LABORATORY DEVICE  
422/68.1 .Means for analyzing liquid or solid sample  
422/78 ..Including means for pyrolysis, combustion, or  
oxidation  
422/80 ...And means directly analyzing evolved gas

2 422/83 (2 OR, 0 XR)  
Class 422 : CHEMICAL APPARATUS AND PROCESS DISINFECTING,  
DEODORIZING, PRESERVING, OR STERILIZING  
422/50 ANALYZER, STRUCTURED INDICATOR, OR MANIPULATIVE  
LABORATORY DEVICE  
422/83 .Means for analyzing gas sample

2 432/19 (0 OR, 2 XR)  
Class 432 : HEATING  
432/1 PROCESSES OF HEATING OR HEATER OPERATION  
432/19 .Controlling flame position or work atmosphere

2 435/252.3 (0 OR, 2 XR)  
Class 435 : CHEMISTRY: MOLECULAR BIOLOGY AND MICROBIOLOGY  
435/243 MICRO-ORGANISM, PER SE (E.G., PROTOZOA, ETC.);  
COMPOSITIONS THEREOF; PROCES OF PROPAGATING,  
MAINTAINING OR  
PROCESS PRESERVING MICRO-ORGANISMS OR COMPOSITIONS THEREOF;  
OF PREPARING OR ISOLATING A COMPOSITION CONTAINING  
A MICRO-ORGANISM; CULTURE MEDIA THEREFOR  
435/252.1 .Bacteria or actinomycetales; media therefor  
435/252.3 ..Transformants (e.g., recombinant DNA or  
vector or foreign or exogenous gene containing, fused  
bacteria, etc.)

2 435/320.1 (0 OR, 2 XR)  
Class 435 : CHEMISTRY: MOLECULAR BIOLOGY AND MICROBIOLOGY  
435/320.1 VECTOR, PER SE (E.G., PLASMID, HYBRID PLASMID,  
COSMID, VIRAL VECTOR, BACTERIOPHAGE VECTOR, ETC.)  
BACTERIOPHAGE VECTOR, ETC.)

2 435/325 (0 OR, 2 XR)  
Class 435 : CHEMISTRY: MOLECULAR BIOLOGY AND MICROBIOLOGY  
435/325 ANIMAL CELL, PER SE (E.G., CELL LINES, ETC.);  
COMPOSITION THEREOF; PROCESS OF PROPAGATING,  
MAINTAINING OR  
PROCESS PRESERVING AN ANIMAL CELL OR COMPOSITION THEREOF;

COMPOSITION  
CONTAINING AN  
OF ISOLATING OR SEPARATING AN ANIMAL CELL OR  
THEREOF; PROCESS OF PREPARING A COMPOSITION  
ANIMAL CELL; CULTURE MEDIA THEREFORE

2 435/471 (0 OR, 2 XR)  
Class 435 : CHEMISTRY: MOLECULAR BIOLOGY AND MICROBIOLOGY  
435/455 .Introduction of a polynucleotide molecule into  
or rearrangement of nucleic acid within an animal  
cell  
435/471 .Introduction of a polynucleotide molecule into  
or rearrangement of nucleic acid within a  
microorganism  
(e.g., bacteria, protozoa, bacteriophage, etc.)

2 435/6 (1 OR, 1 XR)  
Class 435 : CHEMISTRY: MOLECULAR BIOLOGY AND MICROBIOLOGY  
435/4 MEASURING OR TESTING PROCESS INVOLVING ENZYMES  
OR MICRO-ORGANISMS; COMPOSITION OR TEST STRIP  
THEREFORE;  
PROCESSES OF FORMING SUCH COMPOSITION OR TEST STRIP  
435/6 .Involving nucleic acid

2 436/34 (0 OR, 2 XR)  
Class 436 : CHEMISTRY: ANALYTICAL AND IMMUNOLOGICAL  
TESTING  
436/34 RATE OF REACTION DETERMINATION

2 436/55 (1 OR, 1 XR)  
Class 436 : CHEMISTRY: ANALYTICAL AND IMMUNOLOGICAL  
TESTING  
436/55 CONDITION RESPONSIVE CONTROL

2 704/264 (1 OR, 1 XR)  
Class 704 : DATA PROCESSING: SPEECH SIGNAL PROCESSING,  
LINGUISTICS, LANGUAGE TRANSLATION, AND AUDIO  
COMPRESSION/DECOMPRESSION  
704/200 SPEECH SIGNAL PROCESSING  
704/258 .Synthesis  
704/264 ..Excitation

2 800/266 (0 OR, 2 XR)  
Class 800 : MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
PARTS THEREOF AND RELATED PROCESSES  
800/260 METHOD OF USING A PLANT OR PLANT PART IN A  
BREEDING PROCESS WHICH INCLUDES A STEP OF SEXUAL  
HYBRIDIZATION  
800/266 .Method of breeding involving a genotypic or  
phenotypic marker

2 800/268 (0 OR, 2 XR)  
Class 800 : MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
PARTS THEREOF AND RELATED PROCESSES  
800/260 METHOD OF USING A PLANT OR PLANT PART IN A

BREEDING PROCESS WHICH INCLUDES A STEP OF SEXUAL  
HYBRIDIZATION

- 800/268        .Method of breeding involving a tissue culture  
                 step
- 2   800/271        (0 OR, 2 XR)  
     Class   800 :   MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
                     PARTS THEREOF AND RELATED PROCESSES  
800/260        METHOD OF USING A PLANT OR PLANT PART IN A  
                 BREEDING PROCESS WHICH INCLUDES A STEP OF SEXUAL  
                 HYBRIDIZATION  
800/271        .Method of breeding using gametophyte control
- 2   800/298        (0 OR, 2 XR)  
     Class   800 :   MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
                     PARTS THEREOF AND RELATED PROCESSES  
800/295        PLANT, SEEDLING, PLANT SEED, OR PLANT PART, PER  
                 SE  
800/298        .Higher plant, seedling, plant seed, or plant  
                 part (i.e., angiosperms or gymnosperms)
- 2   800/301        (0 OR, 2 XR)  
     Class   800 :   MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
                     PARTS THEREOF AND RELATED PROCESSES  
800/295        PLANT, SEEDLING, PLANT SEED, OR PLANT PART, PER  
                 SE  
800/298        .Higher plant, seedling, plant seed, or plant  
                 part (i.e., angiosperms or gymnosperms)  
800/301        ..Pathogen resistant plant which is transgenic  
                 or mutant
- 2   800/302        (0 OR, 2 XR)  
     Class   800 :   MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
                     PARTS THEREOF AND RELATED PROCESSES  
800/295        PLANT, SEEDLING, PLANT SEED, OR PLANT PART, PER  
                 SE  
800/298        .Higher plant, seedling, plant seed, or plant  
                 part (i.e., angiosperms or gymnosperms)  
800/302        ..Insect resistant plant which is transgenic or  
                 mutant
- 2   800/303        (0 OR, 2 XR)  
     Class   800 :   MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
                     PARTS THEREOF AND RELATED PROCESSES  
800/295        PLANT, SEEDLING, PLANT SEED, OR PLANT PART, PER  
                 SE  
800/298        .Higher plant, seedling, plant seed, or plant  
                 part (i.e., angiosperms or gymnosperms)  
800/303        ..Male-sterile
- 2   800/320.1       (2 OR, 0 XR)  
     Class   800 :   MULTICELLULAR LIVING ORGANISMS AND UNMODIFIED  
                     PARTS THEREOF AND RELATED PROCESSES  
800/295        PLANT, SEEDLING, PLANT SEED, OR PLANT PART, PER  
                 SE  
800/298        .Higher plant, seedling, plant seed, or plant

part (i.e., angiosperms or gymnosperms)  
800/320 ..Gramineae (e.g., barley, oats, rye, sorghum,  
millet, etc.)  
800/320.1 ...Maize

US-PAT-NO: 6275750

DOCUMENT-IDENTIFIER: US 6275750 B1

TITLE: Apparatus for setting heating condition in  
heating furnace and thermal analyzer for object to be  
heated in heating furnace

----- KWIC -----

Abstract Text - ABTX (1):

The present invention relates to a method and apparatus for setting heating conditions in a heating furnace wherein a temperature distribution of an object to be heated is measured required minimum times and thermal analysis for the object is performed, thereby optimally heating the object. When the object to be heated is heated by means of a plurality of heating sources in the heating furnace, heating conditions are set to the heating sources respectively, the object is heated, a temperature of the heated object is then detected at a plurality of detection points, a relationship between a variation in the heating conditions in one of the heating sources and a variation in a detected temperature at each of the detection points of the heated object is computed for each heating source, heating conditions in the heating source for causing the detection point of the heated object to have a target temperature are calculated based on the computed relationship, and the heating sources are controlled on the calculated heating conditions.

US Patent No. - PN (1):

6275750

Brief Summary Text - BSTX (16):

Therefore, the following has been investigated. Thermal analysis is performed by using a computer to quantitatively grasp a heating state in the reflow furnace in order to enhance reliability of the printed-wiring

board.

Moreover, the temperature profile of a heated object in the reflow furnace is predicted and utilized for setting the optimum operation conditions in the reflow furnace.

Brief Summary Text - BSTX (17):

FIG. 10 is a flowchart showing a processing of performing thermal analysis for the printed-wiring board in the reflow furnace using the prior art.

Brief Summary Text - BSTX (18):

At Steps 501 to 507, an analytic model of the printed-wiring board is first generated in order to perform the thermal analysis for the printed-wiring board. On the printed-wiring board are mounted electronic components having several hundred or more junction terminals such as lead frames having fine and complicated shapes which are referred to as a QFP (Quad Flat Package), a SOP (Small Outline Package), a BGA (Ball Grid Array) and the like.

Brief Summary Text - BSTX (26):

Accordingly, it is necessary to accurately calculate a radiation heat quantity received by the printed-wiring board from the infrared heater at Step 508 in order to perform the thermal analysis for the printed-wiring board in the reflow furnace. The Step 508 will be described below.

Brief Summary Text - BSTX (29):

The printed-wiring board receives a heat quantity by convection heat transfer in an atmosphere in the furnace and is thus heated. Therefore, the heat quantity is also calculated at Step 509. The sum of these heat quantities is set as a boundary condition to an analytic model of the printed-wiring board at Step 510.

Brief Summary Text - BSTX (30):

Next, the printed-wiring board having the boundary condition set is analyzed at Step 511. This analysis is executed by a finite element method, a difference method and the like. As described above, the printed-wiring board is carried by means of the conveyer in the heating furnace, and a

relative  
position relationship between each heater and the printed-wiring board  
is  
changed with time. For this reason, the radiation heat quantity  
received by  
the printed-wiring board, that is, the radiation boundary condition is  
not  
constant but is changed with time. Therefore, it is necessary to  
recalculate  
the radiation boundary condition every certain time. Also in a heating  
state  
obtained by the convection, an atmospheric temperature and a convection  
heat  
transfer coefficient are varied depending on a position in the furnace.

Therefore, it is also necessary to recalculate the convection boundary  
condition every certain time. For this reason, it is decided whether  
or not  
the analysis has been performed up to an outlet of the furnace at Step  
512. If  
the outlet of the furnace is not reached, the Steps 508 to 511 are  
repeated.

Brief Summary Text - BSTX (31):

With conventional thermal analysis software, such a boundary  
condition which  
is changed with time has been neither calculated nor automatically set  
to a  
thermal analysis object. Therefore, it has been necessary to manually  
perform  
all these works.

Brief Summary Text - BSTX (33):

Conventionally, the analytic model of the printed-wiring board  
created by  
using much man-day has been set by repetitive calculation of the  
radiation  
boundary condition and the convection boundary condition in each  
position in  
the furnace as described above, thereby performing thermal analysis  
while the  
printed-wiring board enters the reflow furnace and gets out thereof.

Brief Summary Text - BSTX (34):

Thus, the conventional thermal analyzing technique has the following  
problems. Therefore, the thermal analysis for the printed-wiring board  
in the  
reflow furnace could not easily be performed.

Brief Summary Text - BSTX (35):

1+L The thermal analysis object (printed-wiring board) is carried by  
means



of the conveyer in the heating furnace, and radiation and convection boundary conditions are changed with time. Therefore, it is necessary to calculate and set the radiation boundary condition and the convection boundary condition for the thermal analysis object every constant time.

Brief Summary Text - BSTX (37):

In order to solve these respects, accordingly, it is important to develop the method for simplifying the analytic model having high analysis precision which can be applied to non-steady heat conduction analysis (for example, thermal analysis for the printed-wiring board moving in the reflow furnace) for a long time.

Brief Summary Text - BSTX (42):

In order to solve such a problem of the computation time, conventionally, the printed-wiring board has generally been treated as a two-dimensional analytic model to shorten the computation time. In this case, however, electronic components mounted on the substrate are simply modeled. Therefore, heat transfer between the substrate and the electronic component cannot accurately be considered for the analysis so that errors are increased around the components.

Brief Summary Text - BSTX (44):

The present invention has been made in consideration of such circumstances, and provides an apparatus for setting heating conditions in a heating furnace which can measure a temperature distribution of an object to be heated required minimum times or can perform thermal analysis for the object without repeatedly setting the heating conditions many times by a worker's perception or guess, thereby optimally heating the object.

Brief Summary Text - BSTX (45):

Furthermore, the present invention provides a thermal analyzer capable of easily performing thermal analysis for a heated object in a heating furnace without requiring much man-day and specially technical knowledge for the

thermal analysis and of obtaining almost the same temperature distribution result as in a case where the object is actually put in the heating furnace.

Brief Summary Text - BSTX (46):

In addition, the present invention provides a thermal analytic model of a printed-wiring board which can considerably reduce the number of computation elements and can perform thermal analysis in a shorter time than in a case where a conventional analytic model is used.

Brief Summary Text - BSTX (61):

FIG. 10 is a flowchart showing a processing of performing thermal analysis for the printed-wiring board in the reflow furnace by using the prior art;

Brief Summary Text - BSTX (69):

FIG. 18 is a view illustrating a computation grid to perform thermal analysis for a printed-wiring board according to the prior art.

Detailed Description Text - DETX (6):

It is necessary to detect a temperature of the heated object at a plurality of detection points. It is preferable that the number of the detection points should be coincident with that of the heating sources to solve plural simultaneous equations. The temperature of the object may be detected at the detection point by attaching a temperature sensor such as a thermoelectric couple to the object or by performing thermal analysis based on computation. In a case where the computation is to be performed, a thermal analyzing method described in Japanese Laid-Open Patent Publication No. Hei 8-152377 filed on Jun. 13, 1996 by the present applicant can be applied, for example.

Detailed Description Text - DETX (19):

Various display devices such as a CRT display device, a plasma display device and the like and various printers such as a heat transfer printer, a laser printer and the like can be used as the output means.

Detailed Description Text - DETX (22):

Consequently, a user can easily perform the thermal analysis for the object such as the printed-wiring board in the heating furnace by using the thermal analyzer for the object in the heating furnace according to the present invention, for example.

Detailed Description Text - DETX (25):

The present invention further provides a controller for a reflow furnace comprising a thermal analyzer which performs thermal analysis for a printed-wiring board moving in the reflow furnace, and a heating condition setting apparatus for setting heating conditions in the reflow furnace based on a result of the thermal analysis obtained by the thermal analyzer, the thermal analyzer including shape and physical property value input means for inputting a shape of a printed-wiring board to be heated in the reflow furnace and a physical property value thereof, a shape of a component mounted on the printed-wiring board and a physical property value thereof, a shape of a gap space between the component and the printed-wiring board, and a shape of a terminal space having a terminal for connecting the component and the printed-wiring board and a physical property value of the terminal, component and gap space model setting means for setting a model in which the input component and gap space is regarded as a rectangular prism having a thickness that is almost equal to a thickness of the printed-wiring board, terminal model setting means for setting a model in which the input terminal space is regarded as a rectangular prism having a thickness corresponding to a size of the terminal, correcting means for correcting physical property values for the rectangular prism models of the component, the gap space and the terminal space which are thus obtained, computation grid generating means for dividing the rectangular prism model in a grid shape to generate a computation grid and for defining a physical property value for each computation element divided by the computation grid, heating condition input means for inputting heating conditions in the heating furnace, setting means for setting, on the input heating conditions, a radiation boundary condition and a convection boundary condition of the object which are changed with a passage of time,

calculating  
 means for calculating a temperature distribution for each computation  
 element  
 every movement of the object within a predetermined range based on the  
 radiation boundary condition and the convection boundary condition  
 which are  
 set by the setting means and heat conduction in the object for each  
 computation  
 element generated by the computation grid generating means, and output  
 means  
 for outputting the temperature distribution calculated by the  
 calculating  
 means, and the heating condition setting apparatus including heating  
 condition  
 setting means for setting heating conditions to a plurality of heating  
 sources  
 respectively when heating the object by means of the heating sources in  
 the  
 heating furnace, temperature detecting means for receiving, from the  
 thermal  
 analyzer, a temperature distribution for each computation element of  
 the heated  
 rectangular prism model, computing means for computing, for each  
 heating  
 source, a relationship between a variation in the heating conditions in  
 one of  
 the heating sources and a variation in a temperature of each  
 computation  
 element of the rectangular prism model, heating condition calculating  
 means for  
 calculating heating conditions in the heating source for causing the  
 computation element of the rectangular prism model to have a target  
 temperature  
 based on the computed relationship, and control means for controlling  
 the  
 heating sources on the calculated heating conditions.

Detailed Description Text - DETX (41):

The temperatures at the temperature detection points 1 to 4 are not  
 actually  
 measured but may be obtained by performing thermal analysis based on  
 computation. In a case where the temperatures are to be obtained by  
 the  
 calculation, it is possible to apply the thermal analyzing method  
 described in  
 the Japanese Laid-Open Patent Publication No. Hei 8-152377 filed on  
 Jun. 13,  
 1996 by the present applicant and a method using a thermal analyzer  
 according  
 to a second embodiment which will be described below.

Detailed Description Text - DETX (50):

At Step S4, a temperature  $t_{sub.j0}$  at each temperature detection  
 point j on

the basic reflow condition 0 is acquired for the temperature detection points 1 to J on the printed-wiring board 2. In the present embodiment, thermal analysis for the printed-wiring board 2 is performed to obtain the temperature  $t_{sub.j0}$  from a result of the thermal analysis.

Detailed Description Text - DETX (52):

At Step S6, a temperature distribution of the printed-wiring board 2 is acquired on the reflow condition i which has been changed at the Step S5. In other words, a temperature  $t_{sub.ji}$  at each temperature detection point j is acquired. In the same manner as in the Step S4, the thermal analysis is performed to obtain a temperature  $t_{sub.ji}$  at the temperature detection point j on the reflow condition i.

Detailed Description Text - DETX (53):

At Step S7 are calculated a variation  $\Delta t_{sub.ji}$  between the temperature  $t_{sub.j0}$  on the reflow condition 0 and the temperature  $t_{sub.ji}$  on the reflow condition i at the temperature detection point j and a variation  $\Delta T_{sub.ii}$  between the set value  $T_{sub.i0}$  on the reflow condition 0 and the set value  $T_{sub.ii}$  on the reflow condition i in the heating source i. By the following equation, a coefficient  $a_{sub.ij}$  related to the variation  $\Delta T_{sub.ii}$  in the set value of the heating source i and the variation  $\Delta t_{sub.ji}$  in the temperature at the temperature detection point j is calculated.

Detailed Description Text - DETX (55):

At the Step S10, the following simultaneous equations related to a difference  $\Delta tt_{sub.j}$  between the target temperature  $tt_{sub.j}$  at the temperature detection point j and the temperature  $t_{sub.j0}$  on the reflow condition 0 are set up based on a variation  $\Delta tT_{sub.i}$  between a set value  $tT_{sub.i}$  of each of the heating sources 1 to I for causing the temperature detection point j to have a target temperature and the set value  $T_{sub.i0}$  on the reflow condition 0, and the coefficient  $a_{sub.ij}$  obtained at the Step S7.

Detailed Description Text - DETX (65):

FIG. 6 is a block diagram showing a structure of the thermal analyzer for the object in the heating furnace according to the present invention. Since the thermal analyzer for the object in the heating furnace according to the present invention uses a CPU, it will be hereinafter referred to as a thermal analyzing system. There will be described, as an example, thermal analysis in which a reflow furnace is applied as the heating furnace and a printed-wiring board (which is also referred to as a printed board or a substrate) having electronic components mounted thereon is applied as the object. More specifically, description will be given on the assumption that the thermal analyzing system widely performs the thermal analysis for the printed-wiring board during reflow heating. Hardware of the thermal analyzer can serve as a computer and an I/O device which have been used in the apparatus for setting heating conditions according to the first embodiment.

Detailed Description Text - DETX (74):

The reflow condition setting section 104 causes the furnace radiation characteristic data storing section 109 to store information necessary for radiation heat transfer computation such as an area of the heater, a temperature thereof, a position relationship with the printed-wiring board and the like, causes the furnace convection characteristic data storing section 110 to store information necessary for convection heat transfer computation such as a convection heat transfer coefficient and an atmospheric temperature and the like, and updates the contents of the input information.

Detailed Description Text - DETX (77):

wherein F represents a Radiation shape factor indicative of an extent of influence of the radiation,  $\sigma$  represents a Stefan-Boltzmann coefficient, A represents an area of one mesh of the printed-wiring board which is cut into a grid shape, T.sub.H represents a temperature of a heater [K (absolute temperature)], and T.sub.P represents a temperature of the printed-wiring board [K (absolute temperature)].

Detailed Description Text - DETX (79):

wherein h represents a convection coefficient which is related to a wind speed of the blower, A represents an area of one mesh of the printed-wiring board cut into a grid shape, T.sub.A represents an atmospheric temperature [degree. C. (centigrade)] and T.sub.P represents a temperature of the printed-wiring board [degree. C. (centigrade)].

Detailed Description Text - DETX (81):

The analyzing section 119 reads the computation grid stored in the computation grid data storing section 115, and performs a thermal analysis processing based on the radiation boundary condition output from the radiation boundary condition setting section 113 and the convection boundary condition output from the convection boundary condition setting section 114.

Detailed Description Text - DETX (92):

Finally, the temperature distribution data of the printed-wiring board which has been subjected to the graphic processing is displayed on the display device 102 at Step 410. Consequently, a worker for performing the analysis can obtain the result of the thermal analysis for the printed-wiring board.

Detailed Description Text - DETX (94):

The radiation boundary conditions and the convection boundary conditions which are changed with a passage of time in the heating furnace are automatically set every constant time. Based on these boundary conditions, therefore, the thermal analysis is automatically performed every constant time for the analytic model of the printed-wiring board which has the computation grid created. Thus, a temperature profile for each computation grid of the printed-wiring board can be calculated.

Detailed Description Text - DETX (95):

Accordingly, a user can easily perform the thermal analysis for the printed-wiring board in the reflow furnace by using the thermal analyzing system. Consequently, the following excellent effects can be obtained.

Detailed Description Text - DETX (97):

(2) During the thermal analysis, it is not necessary to reset, every constant elapsed time, the radiation boundary conditions and the convection boundary conditions which are changed by the movement of the printed-wiring board in the furnace.

Detailed Description Text - DETX (99):

As a third embodiment, a method for modeling thermal analysis of an object (a printed-wiring board) to be heated in a reflow furnace will be described below. An analytic model according to the present embodiment acts as an analytic model of the printed-wiring board including two or more layered computation elements having the same thickness as in a substrate on one face or both faces of the substrate.

Detailed Description Text - DETX (139):

In the method for modeling the thermal analysis for the printed-wiring board according to the present invention described above, the space between the computation grids was increased so that the number of the computation elements can greatly be reduced and analysis computation can be performed in a shorter time than in a case where a conventional analytic model is used. Furthermore, the analytic model has very few errors caused by the modeling because the corrected physical property values are defined for use depending on an actual shape of a component (a height of a component and a thickness of a component body) and a material.

Detailed Description Text - DETX (143):

According to the thermal analyzer for an object to be heated in the heating furnace in accordance with the present invention, a shape of the object and a physical property value thereof are input, and heating conditions in the heating furnace are input. Consequently, a temperature distribution for each computation grid can automatically be calculated for each movement of the object within a predetermined range based on radiation boundary conditions and convection boundary conditions of the object which are changed with a



passage  
of time, and heat conduction in the object. Thus, thermal analysis can  
easily  
be performed for the object such as the printed-wiring board in the  
heating  
furnace.

Claims Text - CLTX (31):

6. A computer readable recording medium which records a thermal analysis  
program of an object to be heated in a heating furnace, causing a  
computer to  
execute the steps of:

Claims Text - CLTX (38):

7. The computer readable recording medium which records a thermal analysis  
program of an object to be heated in a heating furnace according to  
claim 6,  
wherein the step of inputting a shape of the object and a physical  
property  
value thereof includes a step of inputting a shape of a printed-wiring  
board  
and a physical property value thereof, a shape of a component mounted  
on the  
printed-wiring board and a physical property value thereof, a shape of  
a gap  
space between the component and the printed-wiring board, and a shape  
of a  
terminal space having a terminal for connecting the component and the  
printed-wiring board and a physical property value of the terminal, and

Claims Text - CLTX (40):

8. A controller for a reflow furnace comprising a thermal analyzer  
which  
performs thermal analysis for a printed-wiring board moving in the  
reflow  
furnace, and a heating condition setting apparatus for setting heating  
conditions in the reflow furnace based on a result of the thermal analysis  
obtained by the thermal analyzer,

Claims Text - CLTX (58):

performing thermal analysis for a printed-wiring board moving in the  
reflow  
furnace; and

Claims Text - CLTX (59):

setting heating conditions of the reflow furnace based on a result  
of the  
thermal analysis obtained at the thermal analyzing step,